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Indian Standard

METHODS OF SAMPLING FOUNDRY SAND

(First Revision)

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March 1985

Indian Standard

METHODS OF SAMPLING FOUNDRY SAND

(First Revision)

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Indian Standard

METHODS OF SAMPLING FOUNDRY SAND

(First Revision)

0. FOREWORD

0.1 This Indian Standard (First Revision) was adopted by the Indian Standards Institution on 27 September 1984, after the draft finalized by the Methods of Sampling Sectional Committee had been approved by the Structural and Metals Division Council.

0.2 This standard was originally issued in 1961. Since then a number of Indian Standards on sampling of bulk materials have been prepared. Based on the experience gained in the implementation of these standards, the present revision contains modified provisions on the number of sublots and increment mass. The section on sampling in quarries has been deleted since it requires a different approach altogether. The procedures for sampling no-bake sand have been included. For drawing increment, shovels as well as sand sampler have been recommended.

0.3 For the determination of particle sizes sieves conforming to IS : 460 (Part 1)-1978* or IS : 460 (Part 2)-1978* should be used. If these sieves are not available, other equivalent standard sieves may be used.

0.4 In reporting the result of a test or analysis, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS : 2-1960†.

1. SCOPE

1.1 This standard lays down the procedure to be followed in drawing and preparing samples from a bulk of sand in order to determine the properties of the sand sampled. Sampling from consignments both bulk and packed and on foundry floor have been considered separately.

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*Test sieves: Part 1 Wire cloth test sieves (*second revision*), Part 2 Perforated plate test sieves (*second revision*).

†Rules for rounding off numerical values (*revised*).

1.1.1 This standard also includes a method for reporting the quality of the sand sampled.

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definitions shall apply.

2.1 Sand — Grains of mineral matter which range in size approximately from 0·05 to 2 mm. Sands for foundry purposes generally have size range up to 4 mm.

2.2 Lot — The quantity of sand indicated to be of the same type and grade offered for inspection at one time; a lot may consist of the whole or a part of the quantity ordered for.

2.3 Bed of Sand — A layer of sandy strata which is to be quarried or mined.

2.4 Floor Sand — Prepared (ready-made) moulding sand used for floor moulding purposes.

2.5 System Sand — A naturally occurring or prepared sand used for a specific class of jobs in a foundry operation, from a central and control point.

2.6 Foundry Moulding Sand — The term may include high silica sand, natural moulding sand, synthetic moulding sand mixtures and reclaimed sand placed in heaps on the foundry floor for reuse.

2.7 Sub-lot — The quantity of sand in each of the groups into which a lot or a bed of sand is divided for the purpose of sampling.

2.8 Increment — The quantity of sand collected by filling up the sampling scoop to its capacity in a single motion of the scoop or by using a sand sampler one or more times.

2.9 Gross Sample — The quantity of sand obtained by mixing or crushing together all the increments or specimens collected from the same sub-lot.

2.10 Laboratory Sample — The quantity of sand obtained by reducing a gross sample following a specified procedure, and intended for laboratory testing.

3. SAMPLING OF SAND FROM SAND DUNES AND RIVER BEDS

3.1 While sampling from sand dunes or river beds, each dune or bed shall be treated as a lot and the quantity of sand in each lot shall be estimated with the help of physical measurements. Sampling shall be done only at the time of loading the sand into transport vehicles.

3.2 Sub-lots — The bulk of sand to be sampled shall be divided into number of sub-lots of approximately equal quantities shown in Table 1 by suitably marking the line of demarcation on the surface of the bed.

TABLE 1 NUMBER OF SUB-LOTS INTO WHICH LOT IS TO BE DIVIDED

(*Clauses* 3.2, 4.2 *and* 5.1.1)

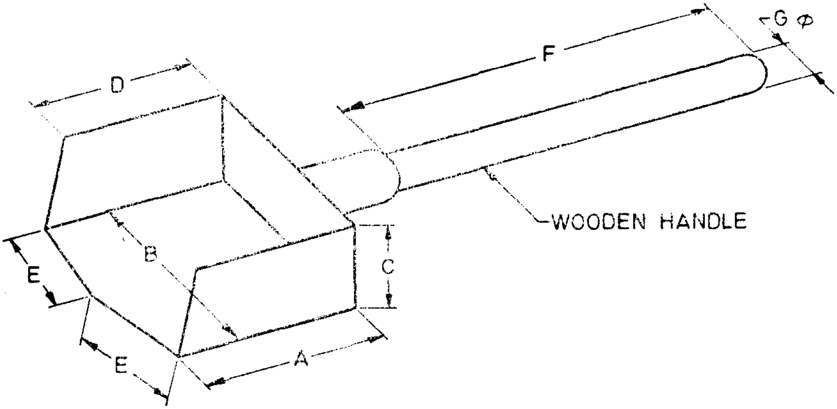
Lot Quantity Tonnes	Minimum No. of Sub-lots
Up to 25	2
26 to 50	3
51 to 100	4
101 to 300	5
301 to 600	6
601 and above	8

3.3 Gross Samples — From each sub-lot, the number of increments specified in Table 2 each weighing about 1·5 kg shall be collected making use of a sampling scoop (Fig. 1). The increments shall be drawn at equal intervals during the course of loading the sand in the sub-lot.

3.4 All the increments collected from the same sub-lot shall constitute a gross sample. Thus, the bed of sand or the sand dune sample shall be represented by as many gross samples as the number of sub-lots into which it has to be divided. Each gross sample shall be separately reduced in accordance with **6.2** and the number of tests shall be in accordance with **8.**

4. SAMPLING OF SAND FROM CONSIGNMENTS

4.1 A consignment of sand which may be delivered at one time or over a period of time is to be sampled as one lot if the sand is from the same source and of the same grade or type. It is always advisable to collect samples, when the material is in motion, that is, during loading or unloading.



NOMINAL CAPACITY OF THE SCOOP	DIMENSIONS OF THE SAMPLING SCOOP (mm)						
	A	*B*	*C*	*D*	*E*	*F*	*G*
1·5 kg	150	150	75	130	90	optional dimensions	

FIG. 1 SAMPLING SCOOP

TABLE 2 NUMBER OF INCREMENTS TO BE COLLECTED FROM A SUB-LOT

(*Clauses* 3.3, 4.3 *and* 5.2.3)

QUANTITY OF SAND OF THE SUB-LOT (TONNES)	MINIMUM NUMBER OF INCREMENTS FROM EACH SUB-LOT	
	Containing Lumps	No Lumps
(1)	(2)	(3)
Up to 10	10	4
11 to 25	15	6
26 to 50	20	8
51 and above	50	10

4.2 Sub-lots — The quantity of sand in a consignment shall be divided into the number of sub-lots of approximately equal quantities, specified in Table 1. If, for instance, a consignment consists of a number of trucks or wagons a sub-lot may consist of a specified number of trucks or wagons satisfying the stipulations in Table 1. If the consignment is in the form of a stockpile, each sub-lot may be properly demarcated before starting sampling operations.

4.3 Gross Samples — From each sub-lot, the number of increments specified in Table 2, each weighing 1·5 kg, shall be collected. Wherever possible, the increments are to be collected at regular intervals when the quantity of sand classified into a sub-lot is being loaded into or unloaded from wagons, ships or trucks. In all the cases, it is necessary to scrap off the top 10 cm to remove the contaminated layer by means of a scoop. Where it is not possible to collect samples during loading or unloading, increments shall be collected from the front, centre and rear of each wagon, truck, etc, from varying depths but not at a depth of less than 15 cm from the sand surface.

4.4 Generally, it is found that silica sand supplies are received in open lorries both in wet and dry condition and pre-graded sand would be in dry condition either in loose form or packed in bags. For wet sand supplies of above one percent moisture sampling scoop as shown in Fig. 1, would be adequate for drawing increments since the load will be fairly homogeneous and there is no possibility of segregation even during transportation. But, dried pre-graded sand supply requires special design of sand sampler in order to obtain a representative sample. An example of sand sampler is shown in Fig. 2. The apparatus consists of a steel tube with diameter 4 cm, length 150 cm with 13 cm tapering at one end and a slit opening of 1·5 cm right from bottom of the pipe up to 55 cm. There will be another tube inside with closing and locking system with a corresponding slit opening. The sampler will have an handle for facilitating easy operation.

4.5 All the increments collected from the same sub-lot shall constitute a gross sample. Thus the consignment of sand sampled shall be represented by as many samples as the number of sub-lots into which it has been divided. Each gross sample shall be separately reduced in accordance with **6.1** and tested in accordance with **8**.

5. SAMPLING OF SAND IN FOUNDRIES

5.1 Sampling of Floor Sand

5.1.1 *Sub-lots* — The quantity of sand on the floor shall be divided into the number of sub-lots, of approximately equal quantities, specified in Table 1 by suitably marking the line of demarcation on the surface of the sub-lot.

5.1.2 *Gross Samples* — From each sub-lot, the number of increments specified in Table 2 each weighing about 1·5 kg shall be collected making use of a scoop or sand sampler the increments shall be collected from the front, centre and rear at a depth of not less than 15 cm below the surface of the sand. The increments shall be collected just immediately after the floor sand has been prepared to avoid variation in moisture, permeability, strength and such other physical properties as would be affected by the exposure.

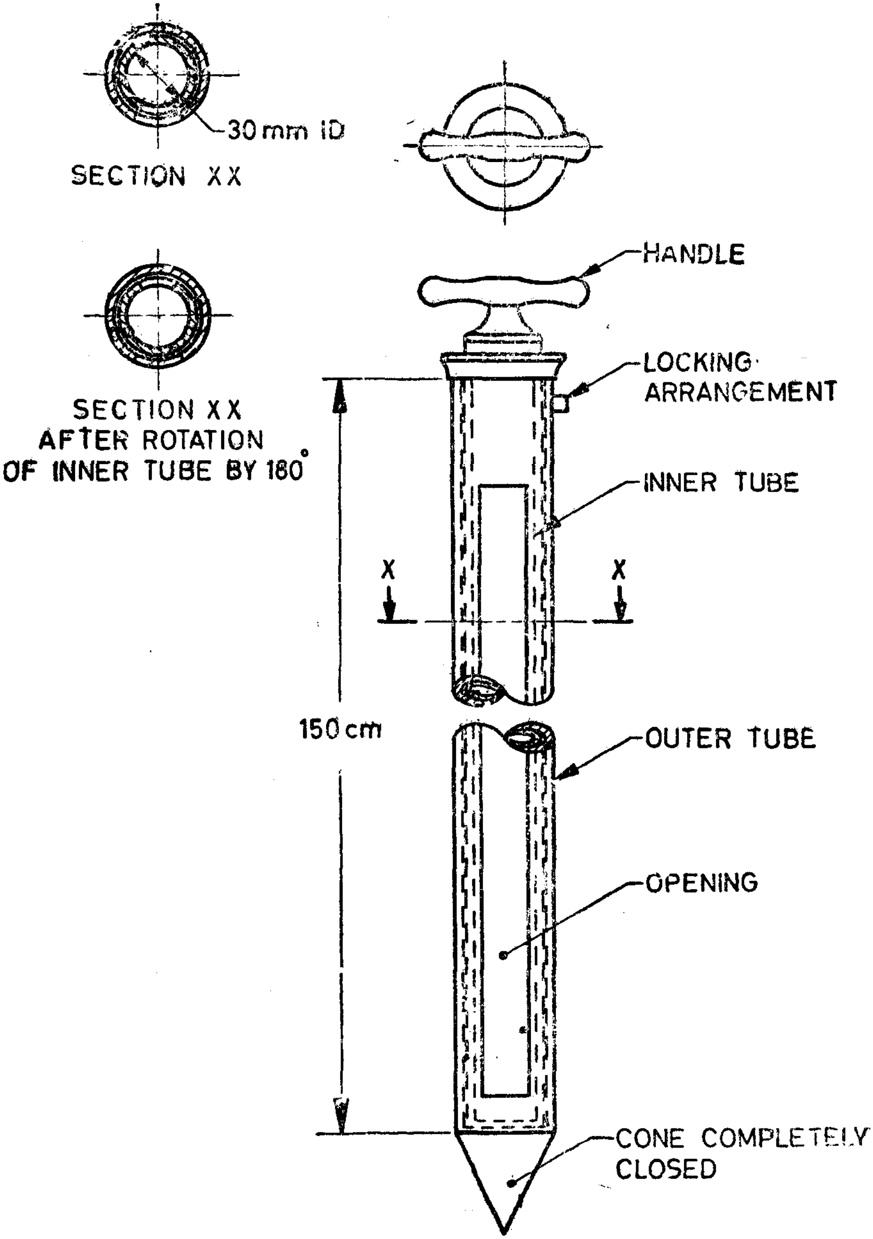


FIG. 2 SAND SAMPLER

5.1.2.1 All the increments collected from the same sub-lot shall constitute a gross sample. Thus the quantity of floor sand sampled shall be represented by as many gross samples as the number of sub-lots into which it has been divided. Each gross sample shall be separately reduced in accordance with **6.1** and tested in accordance with **8.**

5.2 Sampling of System Sands

5.2.1 Gross samples shall be collected from each system of sand mixed at one time from the conveyor after the sand has gone through the sand mixer and aerator; samples could also be collected from hoppers at moulding station. But sampling from conveyor is generally preferable because any changes in the sand can be ascertained more quickly.

5.2.2 *Sub-lots* — The quantity of sand in the system shall be divided into the number of sub-lots, of approximately equal quantities, specified in Table 1.

5.2.3 *Gross Sample* — From each sub-lot the number of increments specified in Table 2 each weighing 1·5 kg shall be collected. When the increments are to be collected from the conveyors belt, they shall be collected at regular intervals of time during transit of the quantity of sand in the sub-lot. If it is not practicable to collect samples on the conveyor, they shall be collected at discharge point or suitable transfer point at equal intervals of time.

5.2.3.1 All the increments collected from the same sub-lot shall constitute a gross sample. Thus the system of sand sampled shall be represented by as many gross samples as the number of sub-lots into which it has been divided. Each gross sample shall be separately reduced in accordance with **6.1** and tested in accordance with **8.**

5.3 Sampling of No-Bake Sand

5.3.1 No-bake sand is prepared by adding binders and accelarators. The sand prepared at one time in one mixing shall be treated as a lot. Samples of such sand shall be collected within 10 minutes after the preparation. The number of increment each weighing about 1·5 kg shall be taken according to the following table from different location of the lot of the prepared sand:

Lot Size kg	*Minimum Number of Increments*
Up to 100	4
101 to 200	5
201 to 500	6

5.3.2 *Gross Sample* — All the increments collected from the lot shall constitute gross sample. This gross sample shall be thoroughly mixed before using it for checking properties such as setting time and shear strength.

6. REDUCTION OF GROSS SAMPLE

6.1 Graded Sand (Like Floor Sand, System Sand, etc) Samples

6.1.1 For reducing a gross sample of graded sand (for example, floor sand, system sand, etc) into a laboratory sample, a riffle sample divider can be used. In case suitable riffle is not available, the method of coning and quartering may be used.

6.1.2 For this purpose the gross sample shall be thoroughly mixed by heaping it into a cone and dismantling it and again forming a fresh cone. These operations may be repeated three times. Each conical heap may be formed by depositing scoopful of material on the apex of the cone so that the portions which slide down the sides are distributed evenly. The cone finally obtained may be flattened by means of a wooden board of sufficient thickness. The flattened material of uniform thickness shall then be quartered along two diameters intersecting at right angles. The use of quartering cross made up of sheet metal of 0·5 cm thickness may be used for this purpose. One pair of diagonally opposite quarters shall be scooped and discarded; the remaining two quarters shall be retained. By this way gross sample shall be reduced to half at every stage and the number of stages depends on the mass of original gross sample and the final sample required.

6.1.3 From each gross sample a laboratory sample of 2 kg shall be obtained by the above procedure for carrying out routine tests as per IS : 1918-1966*.

6.2 Naturally-Bonded Sand or Wet Sand Samples

6.2.1 The gross sample from a lot of naturally bonded sand or wet sand, are likely to contain lumps. Therefore, each gross sample shall be crushed and reduced in different stages as indicated below:

a) The material in the gross sample shall be crushed, over a hard and clean surface protected from rains and free from cracks, to pass through the sieve of square mesh 11·2 mm. This crushed material shall be well mixed and then scooped into a cone shaped pile. Care shall be taken to drop each scoopful exactly over the same spot, otherwise the central axis of the cone will be slackened and an uneven distribution of lumps and fines will result. This cone shall be disturbed and made into a long pile, which is later halved by the alternate scoop methods. Scoopfuls 1, 3, 5, etc, shall constitute the cone A_1, and scoopfuls 2, 4, 6, etc, shall constitute the cone B_1; cone B_1 shall be rejected and cone A_1 shall be processed through the second stage.

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*Methods of physical tests for foundry sands.

b) The material in the cone A_1 shall be further crushed to pass through the sieve of square mesh 9·50 mm and made into a cone again. This cone shall be disturbed and made into a long pile which shall be halved by the alternate scoop method to form cones A_2 and B_2; cone A_2 shall be retained and cone B_2 shall be rejected.

c) The material in cone A shall then be reduced to the requisite quantity as detailed in **6.1.2**, to constitute a laboratory sample.

7. PACKAGING OF LABORATORY SAMPLES

7.1 It is important that containers in which laboratory samples are sent to testing laboratories should be strong enough to withstand rough treatment without being susceptible to such damages as result in the loss of fines, dust, etc. Polythene bags may preferably be used to store laboratory samples to avoid any substantial change in moisture. Tin containers may also be used provided the lids are securely fixed. Each laboratory sample shall be loosely packed without applying pressure in separate containers.

7.2 Each of the containers in which the laboratory samples are packed shall be labelled with full details of identification, namely the source, the type and grade of sand in the lot, sub-lot number. The supplier's name, the date of sampling, the mass of the sample, etc. When the sampling is done from sand dunes or river beds additional details regarding the location of the source may also be included in the label.

8. NUMBER OF TESTS

8.1 All the laboratory samples shall be tested individually for important characteristics of the sand sampled. The decision in this regard may depend on the type of sand and also the end use. For the remaining characteristics, a composite sample of mass equal to at least three times the mass required for the tests shall be prepared by mixing equal quantities of material from each of the laboratory samples.

9. REPORTING

9.1 For those characteristics, where a composite sample has been tested only one test result will be available and that result shall be reported as the value of the characteristic for the bulk of sand sampled.

9.2 For those characteristics where only one laboratory sample has been tested, the result of testing that sample shall be reported as the value of the characteristic for the bulk of sand sampled.

9.3 When only two laboratory samples have been analysed individually, the average of the two available test results shall be reported as the value of the characteristic for the bulk of sand sampled. The individual result shall also be reported to give an indication of the range variation in quality.

9.4 When three or more laboratory samples from a lot have been analysed individually with reference to any characteristic, the following procedure shall be followed to assess the average quality and its limits of variation.

Let $x_1, x_2, x_3 \ldots\ldots\ldots\ldots x_n$ be the results of analysing 'n' laboratory samples for a particular characteristic.

Calculate,

$$\text{Average } (\bar{x}) = \frac{(x_1 + x_2 + \ldots\ldots\ldots\ldots\ldots\ldots x_n)}{n}, \text{ and}$$

Range (R) = the difference between the maximum and the minimum value of the results.

The average level of that characteristic in the lot shall be reported as equal to ($\bar{x}$).

The limits of variation in the average level of the bulk of sand sampled shall be reported as ($\bar{x} + hR$), where 'h' is a factor, whose value depends upon the number of samples analysed. The appropriate value of the factor 'h' shall be taken from Table 3.

TABLE 3 VALUES OF THE FACTOR '*h*'

Number of Laboratory Samples Analysed	Value of the Factor '*h*'
3	1·30
4	0·72
5	0·51
6	0·40
7	0·33
8	0·29

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